Letters to the Editor

'The Ecology of Scale: Assessment of Regional Energy Turnover and Comparison with Global Food' by Elmar Schlich and Ulla Fleissner

Niels Jungbluth[1*] and Martin Demmeler[2]

[1] ESU-services, environmental consultancy for business and authorities, Kanzleistr. 4, 8610 Uster, Switzerland <http://www.esu-services.ch> (jungbluth@esu-services.ch)
[2] Technical University Munich (TUM), Chair of Agricultural Economics and Farm Management, Alte Akademie 14, 85350 Freising-Weihenstephan, Germany <http://www.wzw.tum.de/wdl/> (demmeler@wzw.tum.de)

* **Corresponding author** (jungbluth@esu-services.ch)

DOI: http://dx.doi.org/10.1065/lca2004.11.191

Schlich & Fleissner (2004) recently published an article about the 'Ecology of Scale'. The article focuses on the questions whether food items from regional production are more environmentally sound than global food products. They come to the conclusion that there is a strong relation of the specific 'energy turnover' and the business size. This is termed by the authors as an 'Ecology of Scale'.

A previous article on the same issue (Schlich & Fleissner 2003) found a high public echo that lead to headlines like "No more bad conscience while buying products from New Zealand" (die tageszeitung, 11.11.2003), "Vine from Chile – for the environment?" (Süddeutsche Zeitung, 14.11.2003) or "Energy analysis of food – why apple juice from overseas can be produced with a lower energy input" (Deutschlandfunk 11.11.2003).

As these conclusions partly contradict the common knowledge about environmentally sound behaviour, they should be thoroughly reviewed. Several assumptions for the system boundaries, representativeness of data and some calculations are quite critical for the final conclusions and are not correct in our point of view. We would like to set a question mark on the methodology used for this research work and on the conclusions made in this article.

No LCA methodology: The introduction of the article gives the impression that this research work has followed the ideas of an LCA, but the methodology itself of investigating 'energy turnover' is only described in part. The underlying Ph.D. thesis (Fleissner 2002) only investigated direct end energy uses in the life cycle. Different types of energy carriers are not followed up to the cradle as is the common idea in LCA. Energy carriers are just added based on the consumed end energy (e.g. kWh of electricity and litres of diesel). This is not the same as the so called 'energy component' of an LCA that investigates the use of primary energy resources, e.g. crude oil or uranium, from cradle to grave.

Several environmental aspects of juice production are not analysed (e.g. emission of air pollutants or pesticides, nitrification due to fertilizer use, etc.). In our point of view the term 'ecology' cannot be justified with a calculation of some direct energy uses, because this does not describe the environmental impacts of such processes. In our point of view the so called 'energy turnover' can best be qualified as an analysis of end energy uses.

No reflection of the state of the art: The state of science cited in the article does not reflect the research works on different issues of regional food products, business scales, etc. that have been performed in the recent years. There are, for example, research works on different farm sizes (e.g. Gaillard & Rossier 2001), bread produced on different scales (Andersson & Ohlsson 1999, Görlich 2003, Halberg & Weidema 2004, Probst 1998) or apple production (Stadig 1998) in different countries which already focused on such questions in detailed LCA studies. Thus, this theme is not fully new to the LCA community and has been investigated beforehand. The potentials and restrictions of regional products have been investigated in much more detail (e.g. Hofer & Stalder 2000) than in the studies cited in the article that date back to the early nineties.

Unbalanced system boundaries for process stages: The energy input for producing fruits, chemicals, materials, etc., which are used in the life cycle of juices, is not investigated. Irrigation for orange plantation, for example, might be quite important for the direct energy use, but it is not investigated. It can be assumed that it is not necessary for apple production. Limitation due to the exclusion of the agricultural stage for fruit production and all indirect inputs have not been discussed in the article.

Missing representativeness of the processing plants: The article and the title give the impression that the data is typical for the analysed regional and global products. Regional production plants are only rarely as small as assumed in the article. As **Fig. 1** shows, the analysed regional processing plants are part of a class of plant sizes that represent less than two percent of the apple juice that is processed in Baden-Württemberg, for instance. In the article, one can find neither a justification for this specific data, nor is the variability of the data of the regional plants mentioned. Nearly 80 percent of the regional apple juice in Baden-Württemberg is produced in plants with more than 1,000 tons of fruits per year. The apples delivered to the plants come from the local area, less than 30 km away from the plant, and, for the

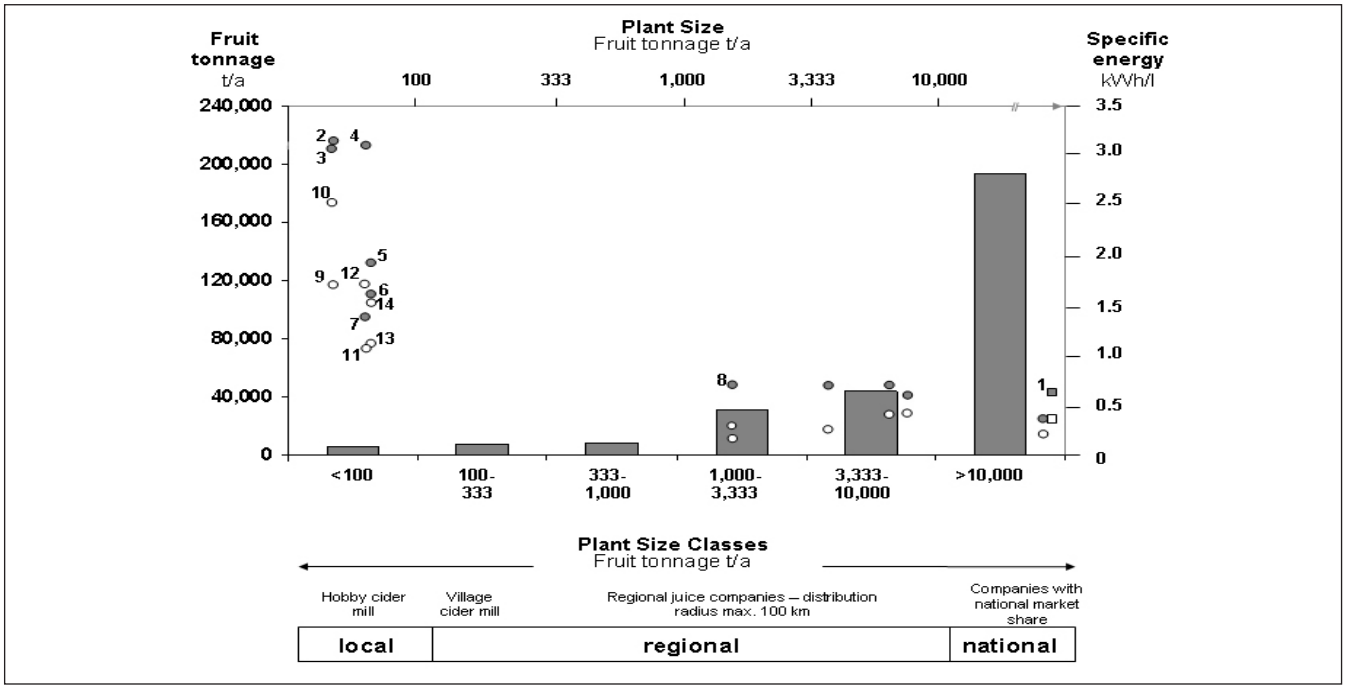

Fig. 1: Specific energy turnover for the production (unfilled symbols) and for production plus transport and distribution (filled symbols) in kWh/l versus fruit tonnage (t/a) (apple juice marked by points, orange juice marked by quadrangles; partly cited in Schlich & Fleissner 2004: Fig. 2 from Fleissner 2002:A-28ff). Summarized fruit tonnage (t/a) versus plant size classes (t/a) (columns, data: Demmeler & Heißenhuber 2004, VdAW 2000) for the production of apple juice in Baden-Württemberg

distribution of the juice, the maximum distance is 100 km away from the plant transported by large lorries. Besides this, in the article, there is no discussion about processing and transportation on a national or European level either, although it is fair to assume that there are advantages in the 'energy turnover' of the transport sector on this scale.

Surprisingly, the only data point for orange juice and thus for a global product, that has been investigated by Fleissner (2002) is not shown in Fig. 2 of the article (Schlich & Fleissner 2004). Showing this data point (cp. 1, Fig. 1), contradicts the results for an 'Ecology of Scale'.

The number of investigated plant sites and sizes might not be sufficient to support the conclusions in a statistical way. In several studies it has been shown that there is a large variation of direct energy uses or environmental impacts at different production places, but only a low dependence on the size (Gaillard & Rossier 2001, Probst 1998). Uncertainties due to the limited number of data of about a dozen different plants have not been discussed in the article.

Antithetical assumptions and value judgements are derived in the Ph.D. thesis of Fleissner and in the article. The conclusion of Fleissner (2002: 158) is: "Every plant can produce efficiently, if a modern technology is used." In contrast, Schlich concludes, on the basis of the same data, that there exists a scale effect depending on the size of the plant.

Unbalanced system boundaries for transports: For the 'energy turnover', different boundaries for regional and global products were defined: In the case of the supraregional and global juices, the 'point of sale' is the system boundary, but it is the household for regional juice (Fleissner 2002: 81). The 'energy turnover' of the regional products includes the shopping trip made by the consumer (cp. 2–8, Fig. 1), but it is excluded for the global products. The results of the change in 'turnover' is therefore remarkable: In the case of regional juice from one regional cider mill (cp. 8, Fig. 1), the extra energy used for the shopping trip adds up to more than half of the total 'energy turnover' of the transports.

The transports distance for orange juice from the harbour to the consumer in Germany is assessed with 400 km. Taking another place of consumption (e.g. Munich) can easily double this distance.

The assessment has only been made for orange juice that is transported in concentrated form. The product is also available as direct juice, transported deep frozen, but not concentrated, which has an important impact on the transported weight and thus on the energy use for the transportation. It is well known that not only distance but also transport mode play a crucial rule for LCA studies of transports. Thus, some more scenarios on these transports would be recommendable if general conclusions are to be drawn.

Unbalanced system boundaries for processing: The definition of the boundaries are different for regional and global juice. The 'energy turnover' of the supraregional und global products cover only the process of production; in contrast, the 'turnover' of the regional products additionally includes the room heating in the production plant (Fleissner 2002: A-40). In the balance sheet, a theoretical energy value was taken for the heater for the entire year. But the use of the heater is – due to the very small quantity of apple juice produced – limited to a use for a maximum of four weeks in

early autumn just before the heating period starts. Using equal boundaries for the juice produced at a small regional scale cider mill (cp. 9 and 10 in Fig. 1; for 11–14 in Fig. 1 detailed data are not published) results in a better energy turnover than for the juice from the global company with much higher juice processing capacities.

Calculation errors: The data used for the calculation of the 'energy turnover' differ from the data sampled in the interviews. For regional juice from an average plant size (cp. 8, Fig. 1) the information was given that 80 percent are sold by wholesale and 20 percent are picked up privately from the cider mill. In the calculation, 10 percent were sold by wholesale and 90 percent went directly to private households (Fleissner 2002: A-35). Due to this discrepancy, the 'energy turnover' for the transport of the regional juice is six times higher than it would be according to the sampled data.

No evaluation of climatic influences: In their description of the production processes for lamb meat in Germany and New Zealand the authors point out that the main differences in farming practice are caused by different climatic conditions, which makes the production of feed and the use of shepherds necessary in the case of Germany. In the conclusions, business size is claimed to be the main factor for the difference in energy turnover, but small scale and large scale farms operating under the same climatic conditions have not been investigated separately. The detailed evaluation in the thesis shows a lower degression (Fleissner 2002:155). Influence of climatic conditions have also been investigated beforehand in LCA, e.g. for tomatoes (Jolliet 1993).

Conclusions

The article confirms the knowledge in the LCA community that regional products are not always environmentally preferable. As shown in this article, the size of production places is one factor that has to be studied in LCA. But we think that many other factors are just as important, e.g. the environmental performance of the individual plants, background technology such as for electricity, production of different types of fruits, natural conditions, etc. To assess and compare the environmental advantages and disadvantages of different production chains, detailed knowledge is necessary about the different ways of production, transport distances and transport modes. For an environmental comparison, different types of environmental impacts have to be followed up to the cradle and down to the grave if it is intended to assess the 'ecology'.

In our point of view, this article is not critical enough in evaluating and generalizing all these different influencing factors and impacts. The methodology used does not reflect the present state of the art for LCA studies or a good praxis according to the ISO 14040 ff standards (International Organization for Standardization (ISO) 1997–2000). The review of previous works is not up-to-date. There are several unbalanced definitions of system boundaries. In the interpretation of the data important aspects have been neglected or suppressed. Thus, summarizing these comments, we think that the main conclusions in this article cannot be justified by the underlying research work.

Most of the remarks and critics in this letter have been discussed with the main author at a symposium about previous articles and a press release on this issue (Heißenhuber et al. 2004).

We hope that the data, which have been investigated with some effort, will be useful for LCA studies which follow up environmental impacts from cradle to grave, complemented with environmentally relevant information. They might be used to carefully draw conclusions from such an analysis considering all relevant aspects without any prejudices.

References

Andersson K, Ohlsson T (1999): Life Cycle Assessment of Bread Produced on Different Scales. Int J LCA (1) 25–40

Demmeler M, Heißenhuber A (2004): Energieeffizienzvergleich von regionalen und überregionalen Lebensmitteln – das Beispiel Apfelsaft. In: Ländlicher Raum Vol. 2004 (2) 1–10 <http://www.wzw.tum.de/wdl/wirueberuns/personen/demmeler/energieeffizienz_regionale_lebensmittel_16.2.pdf>

Fleissner U (2002): Energetische Bewertung der Bereitstellung ausgewählter regionaler und überregionaler Lebensmittel. Berichte aus der Ernährungswissenschaft, Shaker, 170 pp, Aachen

Gaillard G, Rossier D (2001): Bilan écologique de l'exploitation agricole, Méthode et application à 50 entreprises., Eidg. Forschungsanstalt für Agraökologie und Landbau (FAL), Zürich and SRVA, Lausanne, Zürich

Görlich S (2003): Ökobilanz – Vergleich bei der Brotherstellung. Diploma thesis, FHBB Fachhochschule beider Basel, 121 pp, Muttenz, CH

Halberg N, Weidema B (2004): Life cycle assessment in the Agri-food sector. DIAS report no. 61, ISBN/ISSN, pp 1397–9892 <http://www.lcafood.dk/lca_conf>, Horsens, Denmark

Heißenhuber A, Demmeler M, Burdick B, Gensch CO (2004): Ergebnispapier zum Symposium in Kassel: Bilanzen von Lebensmitteln aus der Region – aktuelle Forschungsergebnisse auf dem Prüfstand. Workshop minutes, 19.7.2004, Kassel. unpublished. München, Düsseldorf, Freiburg

Hofer K, Stalder U (2000): Regionale Produktorganisationen als Transformatoren des Bedürfnisfeldes Ernährung in Richtung Nachhaltigkeit? Potenziale – Effekte – Strategien., Universität Bern, Schweiz

International Organization for Standardization (ISO) (1997–2000): Environmental Management – Life Cycle Assessment., European standard EN ISO 14040ff, Geneva

Jolliet O (1993): Bilan écologique de la production de tomates en serre. In: Revue suisse Vitic. Arboric Hortic 25 (4) 261–267

Probst B (1998): Ökologische Beurteilung unterschiedlicher Produktionssysteme von Brot unter besonderer Berücksichtigung Regionaler Produktion: Ein Vergleich auf Basis der Ökobilanzierung. Diplomarbeit, Philosophisch-naturwissenschaftliche Fakultät, Universität Bern, 163 pp, Bern

Schlich EH, Fleissner U (2003): Comparison of Regional Energy Turnover with Global Food. Gate to EHS <http://dx.doi.org/10.1065/ehs2003.06.009>

Schlich EH, Fleissner U (2005): The Ecology of Scale: Assessment of Regional Energy Turnover and Comparison with Global Food. Int J LCA 10 (3) 219–223

Stadig M (1998): Life-cycle-assessment of apple production in Sweden, New Zealand and France. The Swedish Institute for Food and Biotechnology, Göteborg

VdAW (2000): Ergebnisse der Mostobstkampagne 2000. Unveröffentlichte Erhebung, Verband der Agrargewerblichen Wirtschaft